

NOTES AND EXTRACTS.

DIFFERENCES OF STILL AND WHIRLED PSYCHROMETERS.

[By Junior Prof. T. RUSSELL.]

A number of Signal Service stations have recently been supplied with whirling psychrometers. The readings of these and of the still psychrometers made at the same time show the extent to which the two differ.

The whirling machines, on which the whirled wet and dry bulbs are mounted, are set up inside the shelters in which the still thermometers are placed. The shelters in most places are set up on the roofs of buildings and about eight to twelve feet above the roof. The shelter is a single louvre structure three and a half feet by three feet, and three feet in height, with a double top, a closed bottom, and door opening to the north.

The still thermometers have spherical bulbs and the whirled ones cylindrical bulbs.

Corrections have been applied to the thermometer readings for instrumental error in all the readings except those of the dry-bulb still thermometer at San Francisco. That instrument was never compared with a standard.

Whirling is intended to diminish the effect on the bulbs of the thermometers of radiation from the sides of the shelter when the sides happen to be warmer or colder than the air. It is also intended to obviate the bad effects on the readings of wet-bulb thermometers arising from an insufficient renewal of the air around the wet-bulbs, especially at times when there is not much wind prevailing.

Table I gives the mean differences, for the months of August and September, between the dry-bulb thermometers, still and whirled.

TABLE I.—Differences of still and whirled dry-bulb thermometers, in degrees Fahrenheit. August and September, 1886.

[Plus sign indicates still reads higher than whirled.]

Station.	Month.	3 a. m.	7 a. m.	11 a. m.	3 p. m.	7 p. m.	11 p. m.
Albany	Aug.	0	+0.4	0	0.0	0	0.0
Do	Sept.	0	+0.2	0	0.1	0	+0.1
Baltimore	Aug.	0	+0.1	0	+0.1	0	0.0
Do	Sept.	0	+0.2	0	+0.1	0	0.1
Boston	Aug.	+0.2	0.0	+0.1	0.0	+0.1	0.1
Do	Sept.	0.0	0.0	0.0	0.0	0.1	0.1
Buffalo	Aug.	0	+0.2	0	+0.2	0	0.1
Do	Sept.	0	+0.2	0	+0.2	0	+0.1
Cedar Keys	Aug.	0	+0.1	0	+0.1	0	0.1
Do	Sept.	0	+0.2	0	+0.2	0	0.2
Charleston	Aug.	0	+0.4	0	+0.3	0	+0.1
Do	Sept.	0	+0.1	0	+0.2	0	0.0
Cincinnati	Aug.	0	+0.6	0	+0.5	0	+0.5
Do	Sept.	0	+0.3	0	+0.4	0	+0.4
Chattanooga	Aug.	0	+0.5	0	+0.5	0	+0.3
Do	Sept.	0	0.0	0	+0.2	0	0.1
Cleveland	Aug.	0	+0.3	0	+0.3	0	0.0
Do	Sept.	0	+0.1	0	+0.1	0	0.0
Columbus, Ohio	Aug.	0	0.0	0	0.0	0	+0.1
Do	Sept.	0	+0.1	0	+0.1	0	0.0
Davenport	Aug.	0	+0.1	0	+0.1	0	0.1
Do	Sept.	0	+0.2	0	+0.2	0	+0.2
Denver	Aug.	0	+0.2	0	+0.2	0	+0.1
Do	Sept.	0	+0.2	0	+0.2	0	+0.1
Eastport, Maine	Aug.	0	+0.1	0	+0.1	0	0.1
Do	Sept.	0	+0.1	0	+0.1	0	0.1
Eric	Aug.	0	+0.1	0	+0.1	0	+0.1
Do	Sept.	0	+0.1	0	+0.1	0	+0.1
Escanaba	Aug.	0	+0.2	0	+0.3	0	+0.3
Do	Sept.	0	+0.1	0	+0.3	0	+0.3
Grand Haven	Aug.	0	+0.1	0	+0.2	0	+0.2
Do	Sept.	0	+0.1	0	+0.2	0	+0.2
Huron	Aug.	0	+0.3	0	+0.3	0	+0.3
Do	Sept.	0	+0.1	0	+0.2	0	+0.1
Indianapolis	Aug.	0	+0.1	0	+0.1	0	+0.3
Do	Sept.	0	0.0	0	0.0	0	+0.2
Keokuk	Aug.	0	+0.1	0	+0.1	0	+0.2
Louisville	Aug.	0	+0.2	0	+0.3	0	0.0
Do	Sept.	0	+0.2	0	+0.1	0	+0.3
Marquette	Aug.	0	+0.1	0	+0.2	0	+0.2
Do	Sept.	0	+0.2	0	+0.1	0	+0.3
Milwaukee	Aug.	0	+0.1	0	+0.1	0	+0.1
Do	Sept.	0	+0.1	0	+0.1	0	+0.1
New York	Aug.	-0.1	+0.1	+0.2	+0.1	0.0	-0.1
Do	Sept.	0.0	+0.1	+0.3	+0.1	0.0	-0.1
Omaha	Aug.	0	+0.2	0	+0.1	0	+0.1
Do	Sept.	0	0.0	0	0.0	0	+0.1
Olympia	Aug.	0	+0.1	0	+0.2	0	+0.2
Do	Sept.	0	+0.1	0	+0.1	0	+0.1
Oswego	Aug.	0	+0.2	0	+0.1	0	+0.1
Do	Sept.	0	+0.1	0	+0.1	0	+0.1
Portland, Maine	Aug.	0	+0.1	0	+0.2	0	+0.3
Do	Sept.	0	+0.2	0	+0.1	0	+0.3
Portland, Oregon	Aug.	0	+0.2	0	+0.3	0	+0.3
Philadelphia	Aug.	-0.2	-0.1	-0.1	0.2	0.0	-0.3
Do	Sept.	0	-0.1	0	+0.1	0	0.0
San Francisco	Aug.	+0.5	+0.5	+0.5	+0.6	+0.3	+0.6
Santa Fé	Aug.	0	+0.1	0	+0.3	0	+0.1
Do	Sept.	0	+0.1	0	+0.2	0	+0.1
Saint Louis	Aug.	-0.8	-0.4	-0.5	-0.6	-0.7	-0.6
Do	Sept.	0	+0.1	0	+0.1	0	+0.1
Saint Paul	Aug.	0	+0.2	0	+0.3	0	+0.1
Do	Sept.	0	+0.1	0	+0.1	0	+0.1
Toledo	Aug.	0	+0.1	0	+0.3	0	+0.2
Do	Sept.	0	+0.1	0	+0.1	0	+0.2
Valentine	Aug.	0	+0.1	0	+0.1	0	+0.2
Do	Sept.	0	+0.1	0	+0.1	0	+0.2
Washington	Aug.	0.0	0.0	+0.1	+0.2	+0.1	+0.1
Do	Sept.	-0.1	-0.1	-0.2	0.0	0.0	+0.1

In Table II are given the differences between the wet-bulb thermometers, still and whirled. The first column contains for each station the means of all

differences where the wet-bulb reads from zero to three degrees lower than the dry-bulb; the second column the means where the wet-bulb reads from three to six degrees lower than the dry-bulb, and so on. The means are, in some cases, formed from as many as seventy results, and in others from not more than four.

On the average for all the stations the wet-bulb reads from 0° to 3° lower than the dry-bulb in 30 per cent. of the observations. The wet-bulb is from 3° to 6° lower in 28 per cent. of the observations. Wet-bulb 6° to 9° lower than dry-bulb comprises 17 per cent. of the observations; 9° to 12°, 10 per cent.; 12° to 15°, 7 per cent.; 15° to 18°, 5 per cent.; 18° to 21°, 2 per cent.; all others, with wet-bulb 21° or more lower than dry-bulb, 1 per cent.

TABLE II.—Differences of still and whirled wet-bulb thermometers, in degrees Fahrenheit. August, September, 1886.

[Plus sign indicates still reads higher than whirled.]

Whirled wet-bulb lower than dry-bulb.											
Station.	Month.	0° to 3°.	3° to 6°.	6° to 9°.	9° to 12°.	12° to 15°.	15° to 18°.	18° to 21°.	21° to 24°.	24° to 27°.	27° to 30°.
Albany	Aug.	+0.5	+0.7	+1.1	+1.0	+1.2	+1.4	+2.0	0	0	0
Do	Sept.	+0.6	+0.9	+1.3	+1.4	+1.2	+1.4	+2.0	0	0	0
Means		+0.6	+0.8	+1.2	+1.2	+1.2	+1.4	+2.0	0	0	0
Baltimore	Aug.	+0.3	+0.4	+0.3	+0.3	+0.4	0	0	0	0	0
Do	Sept.	+0.4	+0.4	+0.2	+0.2	+0.5	0	0	0	0	0
Means		+0.4	+0.4	+0.2	+0.2	+0.4	0	0	0	0	0
Boston	Aug.	+0.4	+1.0	+0.8	+0.9	+1.3	+1.8	0	0	0	0
Do	Sept.	+0.3	+0.6	+0.7	+0.8	+1.0	+1.8	0	0	0	0
Means		+0.4	+0.8	+0.8	+0.8	+1.2	+1.8	0	0	0	0
Buffalo	Aug.	+0.1	+0.8	+0.7	+2.0	+2.4	+4.0	0	0	0	0
Do	Sept.	+0.5	+1.1	+1.8	+2.2	+3.1	+5.0	0	0	0	0
Means		+0.4	+1.0	+1.2	+2.1	+2.7	+4.0	0	0	0	0
Cedar Keys	Aug.	+0.4	+0.5	+0.5	+0.9	0	0	0	0	0	0
Do	Sept.	+0.3	+0.4	+0.3	+0.3	+0.4	0	0	0	0	0
Means		+0.4	+0.4	+0.4	+0.4	+0.4	0	0	0	0	0
Charleston	Aug.	0.0	+0.1	+0.4	+0.6	+0.3	0	0	0	0	0
Cincinnati	Aug.	+0.1	+0.9	+0.6	+0.6	+0.8	+1.8	0	0	0	0
Do	Sept.	+0.2	+0.5	+0.4	+0.5	+0.5	+1.8	0	0	0	0
Means		+0.2	+0.7	+0.5	+0.6	+0.6	+1.8	0	0	0	0
Charlottesville	Aug.	0.0	+0.1	+0.4	+1.7	+0.7	+0.5	0	0	0	0
Do	Sept.	+0.1	+0.2	0.0	+0.2	+0.6	+0.1	0	0	0	0
Means		0.0	+0.2	+0.2	+0.7	+0.4	+0.3	0	0	0	0
Cleveland	Aug.	+0.8	+1.1	+2.3	+2.0	+3.3	+3.3	0	0	0	0
Do	Sept.	+0.6	+1.2	+2.3	+3.3	+1.5	+4.8	0	0	0	0
Means		+0.7	+1.2	+2.3	+2.6	+1.5	+4.0	0	0	0	0
Columbus	Aug.	+0.4	+0.3	+0.4	0.0	+0.0	+0.3	+2.0	0	0	0
Do	Sept.	+0.4	+0.5	+0.3	+0.5	+0.1	+0.2	0	0	0	0
Means		+0.4	+0.4	+0.4	+0.3	+0.4	+0.2	+2.0	0	0	0
Davenport	Aug.	+0.6	+0.9	+1.2	+1.3	+1.4	+1.2	0	0	0	0
Do	Sept.	+0.4	+0.5	+0.6	+0.7	+0.4	+1.2	+0.8	+0.8	+1.1	+0.9
Means		+0.5	+0.7	+0.9	+1.0	+0.9	+1.2	+0.8	+0.8	+1.2	+0.9
Eastport	Aug.	+0.4	+1.0	+1.1	+1.6	+1.3	0	0	0	0	0
Do	Sept.	+0.2	+0.3	+1.1	+0.9	+1.4	0	0	0	0	0
Means		+0.3	+0.7	+1.1	+1.3	+1.4	0	0	0	0	0
Escanaba	Aug.	0.0	+0.1	+0.1	+0.1	0	0	0	0	0	0
Do	Sept.	0.0	0.0	0.1	0.1	0	0	0	0	0	0
Means		0.0	+0.1	+0.1	+0.1	0	0	0	0	0	0
Grand Haven	Aug.	+0.7	+1.0	+1.4	+1.8	+1.6	0	0	0	0	0
Do	Sept.	+0.3	+0.4	+0.5	+0.7	+1.0	0	0	0	0	0
Means		+0.5	+0.7	+1.0	+1.2	+1.3	0	0	0	0	0
Huron	Aug.	+0.4	+0.4	+1.3	+0.2	+0.3	+1.8	+4.7	+0.0	+0.0	0
Do	Sept.	+0.2	+0.9	+1.1	+1.4	+2.9	+3.4	+0.0	+0.0	0	0
Means		+0.3	+0.6	+1.2	+0.8	+1.6	+3.4	+0.0	+0.0	0	0
Indianapolis	Aug.	+0.0	+0.5	+0.9	+0.9	+1.5	+1.5	+1.7	0	0	0
Do	Sept.	+0.5	+0.5	+0.9	+0.9	+1.4	+1.5	0	0	0	0
Means		+0.5	+0.5	+0.9	+0.9	+1.4	+1.5	+1.7	0	0	0
Keokuk	Aug.	+0.7	+1.4	+2.1	+1.5	+2.4	+2.0	0	0	0	0
Louisville	Aug.	+0.9	+1.0	+3.0	+1.4	+5.3	+7.1	+0.8	0	0	0
Do	Sept.	+1.0	+1.4	+3.4	+5.0	+5.0	+4.0	0	0	0	0
Means		+1.0	+1.5	+3.5	+5.0	+5.0	+5.8	0	0	0	0
Marquette	Aug.	0.0	+0.2	+0.6	0	0	0	0	0	0	0
Do	Sept.	+0.1	+0.1	+0.5	0	0	0	0	0	0	0
Means		0.0	+0.2	+0.6	0	0	0	0	0	0	0
Milwaukee	Aug.	+0.3	+0.7	+0.7	+0.7	+0.4	0	0	0	0	0
Do	Sept.	+0.5	+0.9	+0.9	+0.8	+1.1	+1.4	0	0	0	0
Means		+0.5	+0.8	+0.8	+0.8	+0.9	+1.4	0	0	0	0
Omaha	Aug.	+0.5	+0.7	+0.9	+0.8	+1.0	+1.2	0	0	0	0
Do	Sept.	+0.9	+1.1	+0.9	+1.0	+1.1	+1.2	0	0	0	0
Means		+0.7	+0.9	+0.9	+0.9	+1.0	+1.2	0	0	0	0
Olympia	Aug.	+0.2	+0.4	+0.4	+0.7	0	0	0	0	0	0
Do	Sept.	+0.3	+0.3	+0.5	0	0	0	0	0	0	0
Means		+0.2	+0.4	+0.4	+0.7	0	0	0	0	0	0
Oswego	Aug.	+0.4	+0.3	+0.4	+0.4	+0.7	0	0	0	0	0
Do	Sept.	+0.5	+0.5	+0.5	+0.8	0	0	0	0	0	0
Means		+0.4	+0.4	+0.4	+0.6	+0.7	0	0	0	0	0
Portland, Me.	Aug.	+0.6	+1.6	+2.4	+2.3	+2.4	0	0	0	0	0
Do	Sept.	+0.6	+1.5	+2.0	+2.5	+2.4	0	0	0	0	0
Means		+0.6	+1.6	+2.2	+2.4	+2.4	0	0	0	0	0
Portland, Ore.	Aug.	+0.6	+1.0	+0.8	+1.6	+1.4	0	0	0	0	0
Do	Sept.	+0.8	+1.3	+1.1	+1.9	+2.2	+2.7	0	0	0	0
Means		+0.7	+1.2	+1.0	+1.8	+1.8	+2.7	0	0	0	0
Sacramento	Aug.	+0.3	+0.4	+0.5	+0.6	+1.0	+0.0	+0.7	+0.6	0	0
Do	Sept.	+0.3	+0.4	+0.4	+0.5	+0.5	+0.0	+0.1	+0.1	0	0
Means		+0.3	+0.4	+0.4	+0.4	+0.8	+0.0	+0.9	+0.6	0	0
San Francisco	Aug.	0.0	+0.4	+0.5	+0.2	+0.2	0	0	0	0	0
Santa Fe	Aug.	+0.1	+0.5	+0.9	+1.1	+1.6	+1.9	+3.1	+2.6	0	0
Do	Sept.	+0.7	+0.8	+1.0	+1.0	+1.4	+1.9	+2.9	+2.6	0	0
Means		+0.4	+0.6	+1.0	+1.0	+1.5	+1.9	+2.9	+2.6	0	0
Saint Louis	Aug.	+0.8	+1.8	+2.2	+2.6	+3.2	+3.9	+4.1	+4.6	+5.0	0
Do	Sept.	+1.4	+1.7	+2.1	+3.2	+3.6	+3.6	+3.9	+4.6	+5.0	0
Means		+1.1	+1.8	+2.2	+2.9	+3.4	+3.8	+4.1	+5.2	+5.0	0
Saint Paul	Aug.	+0.7	+1.4	+2.4	+2.7	+3.3	+3.0	+2.1	0	0	0
Do	Sept.	+0.2	+0.2	+0.7	+0.2	+1.9	0	0	0	0	0
Means		+0.4	+0.7	+1.6	+1.4	+2.6	+3.0	+2.1	0	0	0

TABLE II.—Differences of still and whirled wet-bulb thermometers—Cont'd.

Station.	Month.	Whirled wet-bulb lower than dry-bulb.									
		0° to 3°.	3° to 6°.	6° to 9°.	9° to 12°.	12° to 15°.	15° to 18°.	18° to 21°.	21° to 24°.	24° to 27°.	27° to 30°.
Toledo	Aug.	+0.3	+0.5	+0.8	+1.0	+0.8	+0.9				
Do.	Sept.	+0.4	+0.6	+0.8	+1.4	+1.1	+1.2				
Means		+0.4	+0.6	+0.8	+1.2	+1.0	+1.0				
Valentine	Aug.	+0.5	+1.0	+0.9	+1.3	+1.7	+1.7	+1.4	+3.4	+3.3	+4.0
Do.	Sept.	+0.4	+1.0	+1.0	+1.6	+1.4	+2.0	+1.7	+2.3	+3.6	+3.9
Means		+0.4	+1.0	+1.0	+1.4	+1.6	+1.8	+1.6	+2.8	+3.4	+4.0
Washington	Aug.	+0.5	+0.7	+1.2	+1.2	+1.5					
Do.	Sept.	+0.6	+1.2	+1.8	+1.7	+3.0	+1.9				
Means		+0.6	+1.0	+1.5	+1.4	+2.2	+1.9				
Percentage of observations.											
		30.	28.	17.	10.	7.	5.	2.			
Mean of all		+0.4	+0.7	+0.9	+1.2	+1.4	+1.9	+3.1	+3.1	+3.9	

The conclusions drawn from these results are:

1st. The whirled dry-bulb thermometer reads about the same as the still dry bulb. The small differences of the two, shown in Table I, are due in most cases to unavoidable error of observation. This speaks well for the form of shelter adopted by the Signal Service.

2d. The whirled wet bulb reads a good deal lower than the still wet bulb. The difference between the wet bulb "still" and wet bulb "whirled" is greater, the greater the difference between the wet bulb and dry bulb. With the wet bulb two degrees lower than the dry bulb, the whirled wet bulb is 0°.4 lower than the still wet bulb. When the wet bulb is twenty-six degrees lower than the dry bulb the whirled wet bulb reads about 4°.0 lower than the still wet bulb.

3d. The difference between the whirled and still wet-bulb thermometers depends chiefly on the thoroughness of ventilation of the shelter.

4th. From experiments made at the Signal Office in Washington it has been found that the difference between the still and whirled wet bulb depends to some extent on the way muslin is put on the bulb, the way in which the wicking is attached that carries the water to the muslin, and the size and shape of thermometer bulb. If the muslin cover of the bulb is continued around the stem for one inch above the bulb it makes the still thermometer read a few tenths of a degree, Fahr., lower than it otherwise would.

5th. The mean relative humidity for August for twenty stations, computed from the readings of the whirled psychrometer was found to be 70 per cent. With the still psychrometer observed at the same time the relative humidity found from the same tables was 74 per cent.

The following is an extract from the October, 1886, report of the "Alabama Weather Service," P. H. Mell, jr., of the Agricultural and Mechanical College, Auburn, director:

The average precipitation was 2.58 inches below the normal.

The temperature has been comparatively uniform until the close of the month when there was a rapid fall on the last three or four days, forming ice. The temperature was 2°.1 below the normal.

Summary.

Mean temperature, 65°; highest temperature, 90°, at Mount Willing, on the 15th, and at Fayette, on the 14th; lowest temperature, 28°, at Gadsden, on the 30th; range of temperature, 62°; greatest monthly range of temperature, 61°, at Gadsden; least monthly range of temperature, 36°, at Selma; mean daily range, 18°.5; greatest daily range of temperature, 43°, at Eufaula, on the 31st; least daily range of temperature, 4°, at Valley Head, on the 25th.

Mean depth of rainfall, 0.58 inches; mean daily rainfall, 0.019; greatest depth of monthly rainfall, 1.50 inches, at Greensborough; least depth of monthly rainfall, 0.00 inches, at Auburn, Mount Willing, Bermuda, Eufaula, and Oswichee; greatest daily local rainfall, 1.14 inches, at Valley Head, on the 26th.

Average number of days on which rain fell, 2; average number of cloudy days, 3; average number of fair days, 8; average number of clear days, 20.

Warmest day, 14th; coldest days, 28th, 29th, 30th.

Prevailing directions of wind, east and northeast.

The following is an extract from the October, 1886, "Weather Review of the Illinois State Weather Service," Col. Charles F. Mills, director; central office, Springfield:

Temperature.—The mean temperature of the state for the month, 56°.4, was 1°.9 above the normal for twelve years. The mean temperature of the northern division was 53°.9; of the central division, 56°.2, and of the southern division, 58°.8.

The temperature was generally above the normal, but six places reporting a departure below.

The greatest departures occurred as follows: Above the normal—Marengo,

McHenry county, 3°.9; Chicago, Cook county, 3°.5; Oneida, Knox county, 3°.0; Peoria, Peoria county, 4°.1; Mattoon, Coles county, 3°.9; Saint Louis, Missouri, 3°.8; Richview, Washington county, 3°.5. Below the normal—Melvin, Ford county, 1°.2, and Palestine, Crawford county, 1°.5.

The highest temperature reported during the month, 90°, occurred at Fairfield, Wayne county, on the 13th, and the lowest, 25°, occurred at Aurora, Kane county, on the 2d. The highest temperature prevailed on the 13th, and the lowest on the 1st, and 28th to 30th. The absolute range of temperature for the state was 65°; for the northern division, 61°; for the central division, 59°, and for the southern division, 64°. The greatest daily range was 45°, at Pekin, Tazewell county, on the 22d, and the least daily range was 1°, at Fairfield, Wayne county, on the 26th. The mean daily range for the state was 19°.4; for the northern division, 15°.4, and for the central and southern divisions, 20°.1.

Precipitation.—The average precipitation of the state for the month was 1.03 inches; for the northern division, 1.88 inches; central division, 0.98 of an inch, and southern division, 0.54 of an inch. It was 2.73 inches below the October normal for the state; 1.95 inches below for the northern division; 2.67 inches below for the central division, and 3.29 inches below for the southern division.

The precipitation was below the October normal at each of the stations reporting, the departures ranging from 0.06 of an inch to 4.71 inches below.

The most marked departures are as follows: Watseka, Iroquois county, 3.02 inches; Springfield, Sangamon county, 3.32 inches; Pana, Christian county, 3.44 inches; Mattoon, Coles county, 3.84 inches; Griggsville, Bond county, 4.71 inches; Anna, Union county, 3.35 inches, and Golconda, Pope county, 3.69 inches.

The following heavy rainfalls (1 inch or more) were reported: Marengo, McHenry county, 1.22, on the 15th; Cedarville, Stephenson county, 2.50, on the 14th; Oneida, Knox county, 2 inches, on the 14th, and Camden, Schuyler county, 1.13, on the 23d.

From the 1st to the 13th no appreciable precipitation fell. General rains fell on the 13th, 14th, 20th, 23d, and local showers during the remainder of the month.

Inappreciable snowfall was reported at several stations on the 28th.

The greatest monthly precipitation reported was 3.55 inches, at Oneida, Knox county, and the least, inappreciable, at Summer, Lawrence county.

The following meteorological summary and accompanying remarks are from the October, 1886, report of the "Indiana Weather Service," Prof. H. A. Huston, of Purdue University, Lafayette, director:

Districts.	Temperature.			Average precipitation.
	Highest.	Lowest.	Monthly means.	
	°	°	°	Inches.
Northern counties	86.0	29.0	53.8	1.33
Central counties	82.5	23.0	52.2	1.11
Southern counties	94.0	26.0	54.8	0.78
State	94.0	23.0	53.6	1.07

The mean temperature of the state for October, 1886, was 0°.1 below the mean of October for the past three years; 1°.6 below the mean of sixteen years at Indianapolis; 4° above the mean of thirty-one years at Logansport; 4° above the mean of twenty-one years at Vevay; 2°.6 above the mean of thirty-three years at Spiceland; 1°.2 above the mean of seven years at Maury; 5°.8 below the mean of nine years at Blue Lick; 2°.9 below the mean of five years at Worthington; 5° above the mean of seven years at Lafayette. The mean temperature of the various stations ranges from 3° above the average, at Logansport, to 6°.1 below, at Maury.

The mean precipitation of the state for October, 1886, was 1.27 inches below the mean for the past three years; 2.17 inches below the mean of sixteen years at Indianapolis; 1.66 inches below the mean of thirty-one years at Logansport; 1.58 inches below the mean of twenty-one years at Vevay; 1.20 inches below the mean of twenty-eight years at Spiceland; 2.20 inches below the mean of seven years at Maury; 2.31 inches below the mean of five years at Blue Lick; 2.34 inches below the mean of five years at Worthington; 1.88 inches below the mean of seven years at Lafayette. The precipitation at the various stations is below the average, greatest amount, 2.93 inches, at Worthington.

Fogs were reported on the 1st, 2d, 3d, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 16th, 20th, 22d, 25th, 28th, 29th, 30th, 31st.

The high wind of the 14th was prevalent throughout the state, reaching a maximum velocity of forty-eight miles per hour.

Killing frosts occurred on the 1st, 2d, 3d, 22d, 23d, 30th, 31st.

The following is from the advance bulletin (October, 1886) of the "Iowa Weather Service," Dr. Gustavus Hinrichs, director; central station at Iowa City:

October, 1886, was very warm and extraordinarily fine, southerly winds and calms largely prevailing. The month was generally dry, the great total rainfall in middle-eastern Iowa being due to a single very heavy rain on the 13th and 14th.

The mean temperature of the air was 4°.5 above normal. This has been

equalled or slightly surpassed only four times (1884, 1882, 1867, 1841), and largely exceeded only twice (1879 and 1839) during the past forty-eight years. The middle decade was warmest, being 8° above normal; the first decade was 4°, and the third was 2° above normal.

The number of nights with frost was normal, mainly comprising the first and last days of the month.

No snow fell in Iowa during the month, except a very slight show of snow during the forenoon of the 25th, in the northwest of Iowa, namely from Kossuth and Sac county westward.

The sky was remarkably clear, with frequent haze. The total cloudiness was the smallest on record for this month, being only 24 per cent. At the central station no cloudy day occurred, and the number of clear days was sixteen. Only seven evenings of the month were not clear.

The total run of the wind was considerably below normal; fully two-thirds of the time the wind was southerly or calm. The most extended high winds occurred early on the 14th, especially in eastern Iowa.

The number of days with rainfall was low, generally three in the west and five in the east; hence the month was, on the whole, a very dry one. But the rainfall of the evening of the 13th and early morning of the 14th was very great in eastern Iowa, so that the total rainfall for this part of the state is considerably above normal. This rain storm brought over two inches of rain from Jasper to Clayton and Muscatine county, and gave over four inches in Delaware county.

In the state the total rainfall of October was less than one inch in the north-west down to a line drawn from Monona to Black Hawk county. It very rapidly increased eastward, exceeding four inches from Poweshiek to Clayton and Clinton counties, and reaching its highest amount, six inches, in Delaware county.

The most extended thunder-storm of the month occurred on the 23d, bringing the highest rainfall to southern Iowa, and light hail to a few localities. The great rain storm of the 13th was accompanied with thunder and lightning in northern Iowa only.

The following is from the October, 1886, report of the "Minnesota Weather Service," Prof. Wm. W. Payne, Carleton College, Northfield, director:

The mean temperature for the state, as deduced from observations taken at seventeen stations, was 51°.4, which was 8°.7 above that of the corresponding month of 1885.

The month was well marked as regards the extremes in temperature, the maximum being 91°.0, at Spring Valley, on the 5th, and the minimum 10°.2, at Moorhead, on the 1st, thus making the range for the state 80°.8. The greatest monthly range for any station was 75°.0, at Spring Valley, while the least range was 52°.0, at Red Wing.

Fair weather characterized the month, the rain being very light in quantity and extending over but few days.

The mean rainfall was 1.42 inches, which was .50 inch above that of the corresponding month of 1885, but was below the average at places where records have been kept a number of years. At Saint Paul it was greatest, the deficiency being 1.33 inches, while at La Crosse it was .81 inch; Saint Vincent, .70 inch; Moorhead, .56 inch, and Duluth, .47 inch. The greatest amount which fell at any one place was 2.58 inches, at Red Wing; the least amount was .56 inch, at Mankato, which place had a fall of 6.07 inches, the month previous to that being the most for any station in the state. The heaviest precipitation occurred during thunder-storms of considerable severity on the 11th and 23d, 1.52 inches; the greatest daily amount falling on the latter date at Moorhead, while the next greatest daily fall was 1.04 inches, at Red Wing, on the 11th.

The following is from the October, 1886, report of the "Mississippi Weather Service," Prof. R. B. Fulton, of the University of Mississippi, Oxford, director:

Summary.

Mean temperature, 64°; highest temperature, 95°, on 9th, at Lake; lowest temperature, 27°, on 28th, at Hernando; monthly range of temperature, 68°; greatest daily range of temperature, 42°, on 17th, at Macon; least daily range of temperature, 6°, on 29th, at Corinth, and 12th, at Mobile.

Mean monthly rainfall, .49 inch; greatest monthly rainfall, 1.75 inches, at Holly Springs; least monthly rainfall, .01 inch, at Brookhaven; average number of days' rainfall, 2; dates of frost, 2d, 4th, 17th, 28th, 29th, 30th, 31st.

During the month of October, by direction of the United States Signal Service, the following towns in Mississippi have been made cold-wave stations and receive telegraphic warnings when the temperature is likely to fall suddenly below 45°: Oxford, Grenada, Jackson, Crystal Springs, Natchez, Columbus, and Meridian.

Arrangements are being perfected by which, through the courtesy of railroad and telegraph companies, it is expected that the daily weather indications received from Washington can be transmitted to all important towns in the state.

The following is an extract from the October, 1886, report of the "Missouri Weather Service," Prof. Francis E. Nipher, Washington University, Saint Louis, director:

The temperature of October has been 61°.2, which is 5° above the normal

temperature for October. The highest temperature observed was 82° on the 13th, the daily maximum rising to or above 80° five times during the month. The coldest temperature was 36.1 on the morning of the 28th. The air temperature did not fall to the freezing point of water, although in former years it has been known to do so as early as October 4th (in 1836) and has fallen during the month as low as 19°.5 (on October 31, 1863).

The month was fair and pleasant throughout, the middle decade being the warmest of the three. The average temperature of the decades was 62°.2, 67°.2, and 53°.8.

The rainfall of the month was 0.95 inch, 0.84 inch of which fell during half an hour on the 20th. The normal rainfall for October is three inches.

In the state the rainfall has been light. In the southern and southeastern part, with the exception of a small area near Ironton, the fall has been less than one inch. North of this is a belt where the fall was from one to two inches. In the extreme northwest the maximum rainfall of over three inches occurred.

The lowest temperatures reported are 21° at Mound City and 23° at Ironton; the highest are 88° at Pro Tem on the 12th and 88° at Greenfield on the 11th, 12th, and 13th.

As a rule the maximum temperatures throughout the state occurred on or about the 12th, and the minimum on or about the 28th day of the month. Heavy frosts reported from all parts, fourteen stations out of twenty reporting a minimum of below 32° Fahr.

The following is from the October, 1886, report of the "Nebraska Weather Service," Prof. Goodwin D. Swezey, of Doane College, Crete, director:

The weather for October has been warm, dry, clear, and with greater extremes than usual, both of cold and heat.

Two storms of some severity have been felt in eastern Nebraska. The first came from the Northwest on the 13th, and united with one from the Gulf region (the same that caused the severe gales and floods in Louisiana on the 12th and 13th), forming a storm area, extending throughout the Mississippi Valley, central in Iowa. This brought rain in eastern Nebraska, and the lowest barometer of the month. A second storm passed on the 22d and 23d.

The temperature for the month was about three degrees above the normal, being the warmest October since 1879. The rainfall was less than for any October since 1878, being about half the normal amount.

The following summary for October, 1886, is from the "Bulletin of the New England Meteorological Society," Prof. Wm. H. Niles, of Boston, Massachusetts, President:

Summary for October, 1886.

Reports for the month were received from one hundred and forty-eight observers. The temperature of the month runs a little above the mean of October for other years; the rainfall would have been very deficient, but for continued storminess of the last six days of the month, which brought the total precipitation up toward the normal.

The weather experienced may be described under four periods.

First period.—Fair from 1st to 11th; the clearing off of the last storm of September gave hail at noon at Quincy, New Hampshire, and a northwest squall at 15.30* at Gardiner, Maine, followed by cool weather and northwesterly winds, with frosts and ice almost down to the southern coast, up to the 4th or 5th; Nantucket had its first frost on the 2d. On the 4th an area of moderate pressure crossed Canada, giving light rain at several northern stations (Burlington, Vermont, from 16h. to 28h.; Newport, Vermont, 16h. to 18h.; Lunenburg, Vermont, after 21h.; Mayfield, Maine, at night); solar and lunar halos were observed apparently in connection with the upper clouds of this storm at a number of stations even down to the southern coast from the 4th to the 7th, but on account of the unequal attention given to these phenomena by different observers, records of them cannot be well discussed; absence of record cannot be taken as implying absence of halos. Frosts were again noted at several interior stations on the 6th or 7th, and fair weather with warm days (73° to 84° on the 9th) and cool nights under high atmospheric pressure prevailed throughout until the 11th.

The diurnal range of temperature during the passage of high pressure areas in the earlier and later divisions of this period ran as follows: northern interior, 35° to 40°; southern interior, 25° to 35°; coast, 15° to 20°; islands, 10° to 20°. On the 3d and 8th the minimum temperature at the base of Blue Hill (elevation 200 feet) was more than seven degrees lower than the minimum on the summit (635 feet), showing the vertical inversion of temperature characteristic of quiet, clear air at night: this anomalous condition probably prevailed all over New England.

Second period.—Variable from 12th to 18th; high temperature (75° to 82°) preceded a light general rain which fell, except in Connecticut, on the afternoon and night of the 12th and early hours of the 13th, beginning at 16h. to 16h. in the northwest, and at 19h. to 22h. in the southeast; this was in a trough of moderate pressure between anti-cyclonic areas north and south. General rain fell again on the evening and night of the 14-15th, in connection with the passage of a cyclonic area which was well-defined on the Lakes, but which passed far north of New England, and gave us less rain and wind than was expected; the rain began at 18h.-19h. in the west, at 20h. to 23h. in the east, and ended during the night or early on the 16th; high winds, generally northwest, were reported on the 15th and 16th, and on the 16th

*Hours are counted from midnight to midnight; 15.30 being 3.30 p. m.

snow-squalls were frequent at the northern interior stations, followed by the coldest night of the month, giving minima on the morning of the 17th below 15° in the north (Jacksonville, Vermont, 10°; Berlin Mills, New Hampshire, 13°; New Bedford, Massachusetts, 24°; Nantucket, Massachusetts, 34°). This was again followed by light rain in a trough of low pressure at nearly all but the northern stations about midnight of the 17-18th; several solar halos were noticed before and after this rain. The diurnal range during this period was of less value than before, being seldom over 30°, and often under 10°, so that the contrast between coast and interior was much reduced.

Third period.—Fair from 18th to 24th, excepting a light rain at the western and northern stations about 6h. to 10h. on the 21st, attending the passage of a distinctly cyclonic area over Canada; this period was characterized by high pressure and pleasant weather, with clear or fair and mild days, and cool, often frosty nights. The instruments at the top and bottom of Blue Hill again showed a temperature inversion of more than 7° on the 20th, and at Berlin Mills, a valley station in northern New Hampshire, the diurnal range on the 19th and 20th was 47° and 52°.

Fourth period.—Cloudy and rainy from 25th to 31st; this period opened with general cloudiness attending the passage of cyclonic area over Canada, giving light rains to northern stations about 6h. to 11h. An area of high pressure in the west (Wisconsin, 30.70 inches) then suggested that fair weather might be expected, but on the afternoon or evening of the 26th, rain began at nearly all stations, with northeast wind, under the control of a cyclonic storm that was first seen off the Carolina coast, and these unpleasant conditions prevailed during the rest of the month as the storm moved slowly northeastward. Hail fell in Maine on the 27th (Lewiston, 5.30; Gardiner, 6.45), and lightning and thunder were noted at several stations in the evening of the 30th or early on the 31st, when clear sky appeared at some points for a brief interval. Fair weather was not established till November 1st. Under the cover of the clouds and in the presence of the chilly northeast wind, the diurnal range of this period was seldom more than 20°, and was commonly less than 10° or even less than 5°; little contrast could then be found between the coast and the interior in this respect.

The following is from the October, 1886, report of the "Ohio Meteorological Bureau," Prof. B. F. Thomas, director; central office, Ohio State University, Columbus:

The month just closed was unusually pleasant. It was marked by high barometer, average temperature, small rainfall, and clear sky. Only two general rains occurred—one on the 13th, the other on the 28th and 29th.

The mean barometric height was 30.195 inches, .082 inch above the four-year average.

The mean temperature was 53°.2, which was the average of the last three years. The normal temperature for October is 52°.34.

The temperature range for the month was lower than on preceding years, because the minimum, 28°, was higher than usual, the figures for the preceding years being 25°, 18°, and 14°. The clear skies were responsible for an increased daily range of 22°.9, which is the highest daily range for the four years.

More than half the days were reported as clear, and only 6.4 were marked cloudy. The mean rainfall was only 1.27 inches. The four-year average is 2.78 inches, and the normal 2.73. The greatest rainfall was 2.30 inches, at Sidney, and the least, .47 inches, at Cleveland.

Summary.

Mean temperature, 53°.2; highest temperature, 87°.0, on the 13th, at Georgetown; lowest temperature, 28°.0, on the 2d and 3d, at Findlay and Youngstown; range of temperature, 59°.0; mean daily range of temperature, 22°.9; greatest daily range of temperature, 43°.0, on the 13th, at Logan; least daily range of temperature, 2°.5, on the 28th, at Greenville.

Average number of clear days, 16.8; average number of fair days, 7.8; average number of cloudy days, 6.4; average number of days on which rain fell, 6.7.

Mean monthly rainfall, 1.27 inches; mean daily rainfall, .041 inch; great-

est number of days on which rain fell, 11, at Hiram; least number of days on which rain fell, 3, at several places; greatest rainfall, 2.30 inches, at Sidney; least rainfall, .47 inches, signal office at Cleveland.

Prevailing direction of wind, southwest.

The following is an extract from the "Tennessee State Board of Health Bulletin" for October, 1886, prepared under the direction of J. D. Plunkett, M. D., President of the State Board of Health. The weather report is prepared by H. C. Bate, in charge of the State Meteorological Service:

The month of October was remarkable for the small amount of rainfall, and the small percentage of cloudiness, also for the absence of any great amount of electrical disturbances. Altogether the month was very pleasant. It was ushered in with a slight cold wave, resulting in a frost on the night of the 1st.

The mean temperature was 57°.1, nearly three degrees above the mean of October last year, and more than six degrees below that of the corresponding period in 1884. The highest temperature was 88°, recorded on the 11th, and was three degrees above the highest recorded in October of last year, and eleven degrees lower than the highest recorded in October of the previous year. The lowest temperature was 22°, recorded on the 28th and 31st, and was respectively four degrees above and below the lowest of October, 1884 and 1885. The mean daily range of temperature was greater than in October of any of the three preceding years.

The mean depth of rainfall for the month was only 0.97 inch, and is probably by far the smallest amount ever recorded for the month in the state. It is 2.76 inches less than the October mean of last year, 1.29 inches less than that of 1884, and 4.27 inches less than that of 1883. Of the rain that fell during the month, the eastern division received a very large proportion, or an average of nearly one and three-fourths inches; the middle division received an average of less than half an inch, and the western division an average of a little more than half an inch. The greatest rainfall was 3.09 inches, reported at Greenville, and the smallest, 0.20 inch, reported at Covington. The greatest local daily rainfall was 2.05 inches, reported also at Greenville, on the 14th. Other heavy local rains were reported from the eastern division: Andersonville reports 1.16 inches, on the 25th; Jonesborough reports 1.30 inches, on the 26th; Careyville, 1.00 inch, on the 26th; Grief, 1.08 inches, on the 26th; and Fostoria, 1.01 inches, on the 24th. Most of the rains during the month were very light. The days of the greatest rainfall were the 13th, 14th, 25th, and 26th, and of these the heaviest rain was on the 14th, which was the most general rain of the month, the others being confined to the divisions. About twenty days of the month were reported without rain. Dews were reported on about twenty days during the month.

State summary.

Mean temperature, 57°.1; highest temperature, 88°, on the 11th, at Covington; lowest temperature, 26°, on the 28th, at Hohenwald, and on the 31st, at Farmingdale; range of temperature, 62°; mean monthly range of temperature, 50°.5; greatest monthly range of temperature, 57°, at Howell and Sailor's Rest; least monthly range of temperature, 40°, at Greenville and Careyville; mean daily range of temperature, 22°.9; greatest daily range of temperature, 42°, on the 23d, at Beech Grove, and on the 24th, at Rogersville; least daily range of temperature, 2°, on the 26th, at Jonesborough, and on the 28th, at Greenville; mean of maximum temperatures, 82°.7; mean of minimum temperatures, 31°.8.

Average number of clear days, 22; average number of fair days, 4.5; average number of cloudy days, 4.5; average number of days on which rain fell, 3.

Mean depth of rainfall, 0.97 inch; mean daily rainfall, 0.031 inch; greatest rainfall, 3.09 inches, at Greenville; least rainfall, 0.20 inch, at Covington; greatest local daily rainfall, 2.05 inches, on the 14th at Greenville; days of greatest rainfall, 14th, 25th, 26th; day of greatest rainfall, 14th; days without rainfall, all, except 13th, 14th, 17th, 21st, 23d, 24th, 25th, 26th, 27th, 28th, 29th.

Warmest days, 11th, 13th; coldest days, 28th, 31st.

Prevailing winds, north and northwest.